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Product-line deregulation and the cost structure of US savings and loan associations

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Recent legislative actions restrict thrift powers, which were broadened by deregulatory actions in the early 1980s. Using nationwide data for savings and loans (S&Ls), evidence is found that these restrictions may raise intermediation costs for S&Ls by limiting their ability to exploit economies of scope between mortgage-related and other outputs. In addition, economies of scale for a wide size range of S&Ls are found. Evidence is also found to suggest that insolvent S&Ls have higher costs for the same level of outputs than solvent S&Ls.

I. INTRODUCTION

The decade of the 1980s has been a period of upheaval in the American financial services industry. At least partially in reaction to the disintermediation troubles in the 1970s, significant changes in the federal regulations governing depository institutions occurred. As part of the shift in regulations, savings and loan associations (S&Ls) were allowed greater latitude to invest in consumer loans and commercial loans, as well as to participate in a variety of other activities.[1]

Congressional concern that these additional asset powers had possibly been extended too far and, perhaps, contributed to the problems of the thrift industry contributed to the establishment of the Qualified Thrift Lender (QTL) standard in the Competitive Equality Banking Act of 1987. The basic notion of the QTL test is that thrift institutions should have mortgages and housing-related investments as their primary lines of business. The Financial Institutions Reform, Recovery and Enforcement Act of 1989 includes a provision requiring that S&Ls hold at least 70% of their portfolio assets in housing related investments after 1 July 1991. However, the possible production-efficiency consequences of this restriction received little attention.

The purpose of this paper is to investigate whether these expanded asset powers helped contribute to the problems of the industry, and provide some evidence on the issue of whether restricting those powers will increase or decrease intermediation costs for savings and loans. By examining economies of scale and scope for S&Ls, inferences regarding the efficient size and product mix of firms in the industry can be drawn, as can inferences about the possible cost consequences of restricting S&L activities.

This paper is divided into the following sections. A brief summary of the current literature is given, followed by a description of the model to be used in this study, the data and estimation results, and conclusions.

II. LITERATURE SUMMARY

While the topic of the cost structure of firms in the financial services industry has generated a substantial literature, recent evidence suggests that regulatory and technological changes have shifted the structure of costs for financial institutions (Le Compte and Smith, 1990; Gropper, 1991; Hunter and Timme, 1991). As a result, the conclusions of some of the relatively recent studies may be of somewhat limited usefulness for public policy guidance because they analyse data from the 1970s.[2] There are also several studies which analyse data from the early 1980s.[3] The majority of the cost studies of financial firms have been conducted for

[1] A review of the legislative and regulatory developments affecting the thrift industry is provided in Barth and Bradley (1989).
[2] These include Benston *et al.* (1982), Clark (1984), Gilligan and Smirlock (1984), Gilligan *et al.* (1984), Murray and White (1983) and Nelson (1985).
[3] For a recent survey of this literature see Clark (1988).

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commercial banks, and they make up most of the literature discussed here.[4] There are certain aspects of cost structure where a consensus appears to have been reached, and others where considerable variation exists. While most of these studies conclude that any scale economies are exhausted at relatively low levels of output, Hunter and Timme (1986, 1991), Hunter *et al.* (1990), and Lawrence and Shay (1986) found economies of scale across a broad range of bank sizes. Noulas *et al.* (1990) found economies of scale for banks up to US$3 billion in total assets. The issue of economies of scope was examined in some of these studies, although not in all. Evidence of positive scope economies was found by Murray and White (1983), Gilligan and Smirlock (1984), Gilligan *et al.* (1984), Kim (1986), Lawrence and Shay (1986), Kolari and Zardkoohi (1987) and Le Compte and Smith (1990), although certain output pairs were found to have scope diseconomies in the latter three studies. In contrast, Mester (1987b) found no significant economies of scope, while Berger *et al.* (1987) report slight diseconomies of scope. These contradictory results may be due to the different data sets used in the empirical estimation, alternative model specifications and some model misspecifications, as Clark (1988), Humphrey (1990) and others have discussed in detail.[5]

Using data from one of 12 districts, Le Compte and Smith (1990) found evidence to suggest that the structure of costs for S&Ls shifted between 1978 and 1983. This suggests that earlier results may have limited relevance for understanding costs in the new regulatory and competitive environment. Using nationwide data, this study provides further evidence on the cost structure of S&Ls, and allows some inference to be drawn regarding the cost consequences of imposing activities restrictions on thrift institutions.

III. THE MODEL

There are several functional forms which have been widely used in the estimation of cost functions for multiproduct firms. These include the translog, hybrid translog and generalized quadratic, among others. The translog has been most widely used, but it can be criticized because of its inability to handle zero-output levels directly. Some arbitrary data manipulation must be made, or the zero-output observations must be dropped. In addition, calculation of scope economies is troublesome because of this same difficulty in handling zero-output levels. The hybrid translog provides an alternative that allows zero-output levels by using the Box–Cox transformation on outputs rather than the natural logarithm. However, the results obtained with the hybrid translog can be quite sensitive to the value of λ in the Box–Cox transformation. Estimation of such a non-linear model can prove troublesome, particularly if one wants to be fully flexible and allow λ to vary for each output. Moreover, in the hybrid translog model the interpretation of the estimated output parameters is very difficult.

The generalized quadratic cost function (GQCF) provides an alternative to both of the above functions. This form is similar to the translog in that both are essentially second-order expansions of outputs around cost, but the GQCF is in levels, while the translog is in logarithms. As Baumol *et al.* (BPW) (1982) note, the GQCF may be the best suited of the flexible forms to the study of scale and scope economies. Recent research by Röller (1990a, 1990b) provides strong support for the BPW view. This form has been used in a variety of applications.[6] The primary drawback to the GQCF is that it is not easily restricted to be linearly homogeneous in input prices. It is thus most useful to consider the GQCF as an approximation to some true cost function, one which allows costs to vary flexibly with output mix and size.[7]

For empirical estimation, a flexible functional form which imposes only minimal restrictions on the structure of production is desired. In addition, the functional form should not preclude the detection of scope or scale economies, and it should allow the estimated cost curves to take on the U-shaped form postulated by economic theory. The GQCF meets all of these criteria.[8]

Cost model

The specific form of the cost function to be estimated is a variant of the generalized quadratic cost function. As suggested by BPW, substantive flexibility is improved by the use of dummy variables which permit quasi-fixed cost variations among firms which produce different output combinations. This form of the generalized quadratic cost function is known as the flexible fixed cost quadratic (FFCQ) function, which here takes the form:

$$C=\alpha_0+\Sigma_i\alpha_iF_i+\Sigma_i\beta_iY_i+(\tfrac{1}{2})\Sigma_i\Sigma_j\beta_{ij}Y_iY_j$$
$$+\Sigma_i\tau_i\ln P_i+(\tfrac{1}{2})\Sigma_i\Sigma_j\tau_{ij}\ln P_i\ln P_j$$
$$+\Sigma_i\Sigma_j\gamma_{ij}Y_i\ln P_j+\delta\ln B \qquad (1)$$

[4] However, credit unions have been studied by several authors, including Kohers and Mullis (1988), Murray and White (1983) and Taylor (1972).
[5] See Humphrey (1990) for an excellent discussion, and Zardkoohi *et al.* (1986) on the various misspecifications.
[6] Examples include Baumol and Braunstein (1977), Mayo (1984), Cohn *et al.* (1989) and Röller (1990a, 1990b).
[7] As Chambers (1988) and Baumol *et al.* (1982) have noted, estimation of cost functions necessarily involves a trade off between theoretical correctness and empirical tractability.
[8] For more thorough discussions of alternative flexible functional forms see Baumol *et al.* (1982), Berndt and Christensen (1972), Chambers (1988), Christensen *et al.* (1971, 1973), Denny and Pinto (1978) or Diewert (1973).

where C is total cost, the Y_i's are the output quantities, the F's are dummy variables with the value 1 if some positive quantity of the corresponding output Y_i is produced, the P_i's are the input prices and the α's, β's, τ's, γ's and δ are parameters to be estimated. Taken together, the α's indicate the levels of quasi-fixed costs which may vary for different output configurations. Input-price specification in the generalized quadratic model is somewhat flexible; the specification adopted here has been utilized previously (Beard *et al.* 1991). This particular specification is empirically tractable and provides an excellent fit to the data.[9]

Economies of scale and scope

For the multiproduct firm, several different cost concepts are of interest. These include overall and product specific economies of scale, and overall and product specific economies of scope. Following BPW, let $C(Y)$ represent the total cost of jointly producing all of the outputs Y_i from Equation 1, and let $C_i(Y)$ represent the marginal cost of producing the ith output, so that

$$C_i(Y)=\partial C(Y)/\partial Y_i \qquad (2)$$

The elasticity of scale coefficient, S_n, is given by

$$S_n=C(Y)/\Sigma_i Y_i C_i(Y) \qquad (3)$$

Overall scale economies exist if $S_n>1$; constant returns to scale if $S_n=1$; and diseconomies of scale if $S_n<1$.

Product specific returns to scale are given by

$$S_i(Y)=\mathrm{AIC}(Y_i)/C_i(Y) \qquad (4)$$

where $\mathrm{AIC}(Y_i)$ is the average incremental cost of the ith output. $\mathrm{AIC}(Y_i)$ is defined as the additional cost of producing the ith output divided by the quantity of that output produced. If $C(Y_{n-i})$ represents the total cost of producing all outputs except the ith one, then $\mathrm{AIC}(Y_i)=[C(Y)-C(Y_{n-i})]/Y_i$. Values of S_i are interpretable in the same way as values of S_n.

If there are complementarities in the production of the n outputs so that joint production is less costly than separate production, economies of scope are said to exist. Let $C(Y_i)$ represent the cost of producing product Y_i alone. This differs from the marginal cost $[C_i(Y)]$ of producing Y_i because the intercept and quasi-fixed cost parameters are included in the estimated stand alone production costs $C(Y_i)$. The degree of overall economies of scope can then be calculated by

$$SP_n=[(\Sigma_i C(Y_i))-C(Y)]/C(Y) \qquad (5)$$

Economies of scope exist if $SP_n>0$, while diseconomies exist if $SP_n<0$. Economies of scope can also be computed for each output or any subset of outputs separately. Product specific economies of scope (SP_i) for any given output are given by

$$SP_i=\{[C(Y_i, O)+C(O, Y_{n-i})]-C(Y)\}/C(Y) \qquad (6)$$

Interpretation of the product specific economies of scope measure is the same as overall economies of scope.

IV. DATA AND MODEL SPECIFICATION

In this study, the S&L is viewed as a financial intermediary producing various types of loans and investments using labour, capital and funds as inputs. Some cost studies have excluded the interest costs of funds and focused on operating costs alone. Others have included interest costs, and they are included here following the intermediation approach outlined in Mester (1987a). Total costs are the sum of labour, interest and other costs.

Output quantities

The dollar volume of loans and investments is the desired output measure for this study, for several reasons. First, as discussed by Mester (1987a), this is the measure consistent with the intermediation approach used here. Additionally, as a multiproduct firm, the thrift produces a variety of outputs. The only ready measure of comparison for these different outputs is their dollar amount. The output categories of mortgage loans, commercial loans, consumer loans, liquid investments and direct investments are used. Mortgage loans include construction loans, permanent mortgages and mortgage-backed securities. Liquid investments include cash and securities, and direct investments are made up of real estate held for development or investment purposes, and investments in service corporations and subsidiaries. The fields on the Thrift Financial Report tapes used to construct these and the other regression variables are available from the author upon request. Previous researchers have reported results for all loans grouped together. Others have disaggregated to some level, which varies across studies. This study focuses on the different types of loans so as to evaluate the cost consequences of recent regulatory changes.

Input prices

Deposits, borrowed money, labour and capital were the four inputs used in the estimated cost function. Deposits and borrowed money were considered as distinct and different sources of funds. Their average prices were calculated as the sum of the interest paid on each type divided by their average balances. While there are data for total expenditures on labour and capital, there is no information on the

[9] An alternate model with input prices in levels rather than logs was also estimated, to assess the sensitivity of the results to the input price specification chosen here. Although the overall model fit was not quite as good, the scale and scope estimates were similar to those reported here.

quantities of those inputs which would be necessary to calculate average prices. The prices of labour and capital were constructed in a manner similar to that used by Mester (1987b). The price of labour was approximated by the average wage by state paid by firms in the finance, insurance and real estate industry as reported by the Bureau of Labor Statistics. While only approximate, this measure will reflect some variations in labour costs across the country. Any intrastate or other variations in wages paid by S&Ls will be reflected in expenditures on labour, but not in the average price of labour. Information on the costs associated with physical capital is available from balance-sheet data on expenditures. An approximate unit price of capital is constructed following the approach used by Mester (1987b), by dividing expenditures by the volume of deposits.[10]

Preliminary analyses were run on quarterly data alone. The final analyses reported here were done on an annual file compiled by merging data from each quarter of 1988 by institution. The advantage to the merging procedure is that this process mitigates problems caused by one unrepresentative quarter's data. However, this procedure may also spread the problems from one quarter's data to other quarters. In preliminary analysis, a three output model was estimated which did not include any input prices or structural data on the number of branches the S&L operated.[11] This simple model was expanded to include five outputs and four input prices. Descriptive statistics for these variables are given in Table 1. The five outputs were mortgages, commercial loans, consumer loans, liquid assets (cash and securities) and direct investments. The four input prices used were the prices of labour, deposits, borrowed funds and capital. Institutions with negative reported prices were deleted as representing reporting errors, while those with missing prices had the sample mean prices substituted for the missing values. The final dataset used for estimation contained 1589 institutions. Prior to estimation of the regression equation, all variables except the insolvency dummy were divided by their sample mean values to aid in the calculation of the scale and scope measures. Total costs were taken as the sum of all operating and non-operating expenses reported by the institution. Some cost studies include only operating expenses, and thus exclude non-operating costs. While including non-operating costs causes some problems in properly defining cost shares, their inclusion is desired to fully account for the costs S&Ls must actually be able to cover to stay in business. As stated earlier, the intermediation approach for cost studies is followed, so that interest costs are included in total costs, and deposits are considered an input to the production process rather than an output.

Table 1. *Descriptive statistics for basic regression variables (S&Ls)*

Variable	Mean	Standard deviation
TOTCOST	49974.4544	158401.36
MORTGAGE	354155.1632	1276364.20
COMMLOAN	9355.0302	64854.25
CONSLOAN	16486.2253	68132.22
LIQUID	66051.2950	244495.68
DIRINV	12949.7601	62591.99
HWAGE	12.1686	2.06
PDEP	0.0705	0.01
PCAP	0.0291	0.03
PBMON	0.0824	0.04
BRANCHES	8.2480	17.66

Data for 1988 Thrift Financial Report tapes. There were 1589 savings and loan associations in the final sample. The figures for *TOTCOST*, *MORTGAGE*, *COMMLOAN*, *CONSLOAN*, *LIQUID* and *DIRINV* are all reported in thousands. *HWAGE*, *PDEP*, *PCAP* and *PBMON* are the hourly wage, price of deposits, physical capital and borrowed money respectively.

V. ESTIMATION RESULTS

The five-output, four-input price model was estimated on 1988 data. The use of 1988 data allows examination of S&L operations at a time when institutions had an opportunity to adjust to product-line deregulation, and before some recent limitations were imposed. To the extent that cost savings could be realized from product-line deregulation, use of data from this time period allows their detection. The number of branches the institution operated was included, consistent with other studies in this area. An indicator variable to identify which institutions were insolvent was also included.

In cases where the observations which make up the sample differ greatly in size, heteroscedasticity can be a problem. To test for heteroscedasticity, the White test (1980) was run; the value of the Chi-square statistic obtained was 130.85, with a calculated probability of less than 0.001, indicating the presence of heteroscedasticity. In this case, the heteroscedasticity appears to be size related, as some S&Ls are much larger than others. As is well known, heteroscedasticity decreases the efficiency of OLS, although the parameter estimates are still unbiased and consistent. The usual prescription in this case is to increase estimation efficiency by using weighted least squares. Following the procedures outlined in Gujarati (1988), it is assumed that the variance of the error is proportional to the square of the expected value of the dependent variable (*TOTCOST*), and so the data is

[10] The price of capital was also calculated by dividing expenditures by the book value of physical assets, although this procedure has received criticism in the literature (Rangan *et al.*, 1989). However, estimates of overall scale and scope economies were substantially the same with that specification as with the one reported here.

[11] The scale and overall scope results from that model were similar to those reported here.

Table 2. *Economies of scale*

Percentage of output mean	Overall scale economies	Product specific: Mortgage loans	Commercial loans	Consumer loans	Liquid investments	Direct investments
50%	1.0272*	1.0002	1.2913*	0.8029*	1.0032	1.1318*
	(3.453)	(0.047)	(5.328)	(−2.596)	(0.331)	(3.218)
75%	1.0181*	1.0004	1.1614*	0.8565*	1.0048	1.0325
	(2.906)	(0.047)	(3.023)	(−2.548)	(0.331)	(0.821)
100%	1.0136*	1.0005	1.0858	0.8796*	1.0065	0.9716
	(3.131)	(0.047)	(1.318)	(−2.366)	(0.331)	(−0.602)
150%	1.0092	1.0007	0.9883	0.8954	1.0098	0.8920
	(0.891)	(0.047)	(−0.119)	(−1.881)	(0.331)	(−1.676)
200%	1.0069	1.0009	0.9168	0.8960	1.0131	0.8368*
	(0.234)	(0.047)	(−0.615)	(−1.537)	(0.331)	(−2.045)
300%	1.0048	1.0014	0.7973	0.8819	1.0201	0.7589*
	(0.044)	(0.047)	(−0.934)	(−1.210)	(0.330)	(−2.295)

Notes: Values greater than one indicate economies of scale, equal to one indicate constant returns, and values less than one indicate diseconomies of scale. Asymptotic t-statistics are calculated using the procedure of Mester (1987b) and are shown in parentheses. The null hypothesis is constant returns to scale, i.e. scale = 1. * indicates significance at the 5% level.

transformed by dividing all variables by $\hat{Y}_i$, which in large samples are consistent estimators of $E(Y_i)$. The intercept is replaced by a variable equal to $1/\hat{Y}_i$ in WLS estimation. To determine if this transformation addressed the heteroscedasticity problem, the White test was carried out on the new model; the Chi-square value was 99.257 with a calculated probability of 0.665, indicating that the heteroscedasticity problem is no longer statistically significant.

In addition to the test for heteroscedasticity, the estimated cost model was examined for other potential problems. As noted earlier, estimated cost functions may exhibit violations of theoretical cost function properties. To evaluate the severity of such problems in this estimation, several regularity conditions were checked by evaluating the estimated cost function at each observation in the entire dataset, and over the 50% to 300% of mean outputs used as the region over which to calculate scale and scope economies.

The estimated cost function is non-negative over 1504 (94.6%) of the 1589 observations in the dataset.[12] The estimated cost function is strictly positive over the region of approximation for the scale and scope measures reported in Tables 2 and 3. Estimated marginal cost values were also checked at the points of approximation shown in Tables 2 and 3, and all estimated marginal costs were strictly positive. However, checking marginal costs for each observation in the dataset showed more violations of regularity conditions. There were no negative estimated marginal costs for mortgage loans, and estimated marginal costs for consumer loans and for liquid investments were positive for 98.4% and 99.7% of the observations respectively. However, estimated marginal costs for commercial loans and direct investments were negative for 34.7% and 41.8% of the dataset respectively. Checking the standard errors associated with these point estimates showed that only two of the 1589 observations in the dataset exhibited negative estimated marginal costs which did not include positive values in a 95% confidence interval around the point estimate. Thus, there are a limited number of regularity violations which appear to be, in the above sense, statistically significant. As noted earlier, problems of this sort often arise in empirical cost studies, particularly when disaggregated elements of the output vector are examined individually for each observation in a large dataset. Similar problems have been noted in Chambers (1988), Baumol *et al.* (1982), Röller (1990b) and in many other discussions of applied cost estimation. It is important to note that the cost function estimated here does exhibit theoretically proper behaviour over the region of the data used to calculate the scale and scope measures, which are the primary measures of interest for this investigation.

The parameter estimates obtained from the WLS regression are given in Table 4, and are the basis for the scale and scope calculations presented in Tables 2 and 3.

The first-order parameters on each output are positive and statistically significant. The intercept dummy variables for commercial loans and direct investments are positive as expected, while the coefficient for consumer loans is, surprisingly, negative. These coefficients illustrate how quasi-fixed costs vary with output mix, as Baumol *et al.* (1982) suggest.

[12] Another regression was run where these 85 observations were dropped, and the cost function re-estimated. This re-estimation still produced negative predicted costs for 35 observations; moreover, the scale and scope estimates obtained were similar to those reported in Tables 2 and 3.

Table 3. *Economies of scope*

Percentage of output mean	Overall scope economies	Product specific				
		Mortgage loans	Commercial loans	Consumer loans	Liquid investments	Direct investments
50%	7.839%*	1.991%*	2.117%*	1.987%*	1.914%*	1.987%*
	(5.387)	(3.764)	(5.298)	(5.142)	(4.533)	(5.044)
75%	5.494%*	1.420%*	1.612%*	1.415%*	1.304%*	1.415%*
	(5.207)	(2.186)	(4.480)	(4.452)	(2.950)	(4.167)
100%	4.373%*	1.156%	1.413%*	1.149%*	0.999%	1.149%*
	(4.633)	(1.384)	(3.519)	(3.509)	(1.843)	(3.145)
150%	3.376%*	0.938%	1.326%*	0.928%*	0.703%	0.928%
	(3.169)	(0.755)	(2.392)	(2.188)	(0.883)	(1.892)
200%	3.008%*	0.879%	1.396%	0.864%	0.564%	0.864%
	(2.247)	(0.529)	(1.914)	(1.574)	(0.530)	(1.349)
300%	2.909%	0.917%	1.696%	0.896%	0.444%	0.896%
	(1.473)	(0.367)	(1.554)	(1.099)	(0.277)	(0.939)

Notes: The values shown above all indicate positive economies of scope. They represent the estimated percentage cost savings from joint production of the stated outputs. Asymptotic *t*-statistics are given in parentheses. The null hypothesis is no economies of scope; i.e. scope = 0%. * indicates statistical significance at the 5% level.

Table 4. *Quadratic cost function WLS parameter estimates*

Variable	Parameter estimate	Standard error	T for H_0 parameter $=0$
INTERCEP	0.0098389	0.0018842	5.222
COMMFIX	0.0040589	0.0003734	10.870
CONSFIX	−0.0029377	0.0011049	−2.659
DIRVFIX	0.0027547	0.0003796	7.257
MORTGAGE	0.8080320	0.0075349	107.239
COMMLOAN	0.0247889	0.0031525	7.863
CONSLOAN	0.0322207	0.0029362	10.974
LIQUID	0.1212670	0.0053171	22.807
DIRINV	0.0253890	0.0042694	5.947
MORTSQ	−0.0003825	0.0080760	−0.047
MORTCOMM	0.0017288	0.0020293	0.852
MORTCONS	−0.0040585	0.0038450	−1.055
MORTLIQD	0.0018921	0.0058171	0.325
MORTDIRV	−0.0015764	0.0032602	−0.483
COMMSQ	0.0019899	0.0015408	1.291
COMMCONS	−0.0005328	0.0009743	−0.547
COMMLIQD	−0.0031365	0.0031877	−0.983
COMMDIRV	−0.0027092	0.0011336	−2.390
CONSSQ	0.0009331	0.0009543	0.978
CONSLIQD	0.0005704	0.0029465	0.193
CONSDIRV	0.0020810	0.0025148	0.827
LIQDSQ	−0.0007717	0.0023228	−0.332
LIQDDIRV	0.0002622	0.0026336	0.099
DIRVSQ	0.0036261	0.0013823	2.623
RAPINS	0.0365656	0.0037650	9.712
PDEP	0.0432294	0.0080306	5.383
PDEPSQ	−0.0561493	0.0614116	−0.914
WAGE	0.0014066	0.0037159	0.378
WAGESQ	0.0639923	0.0178757	3.580
PCAP	−0.0084216	0.0018420	−4.572
PCAPSQ	0.0313396	0.0040176	7.801
PBMON	0.0031993	0.0009848	3.248
PBMONSQ	0.0010588	0.0008053	1.315
PDPCAP	0.0070310	0.0119717	0.587
PDPBMON	0.0355708	0.0064114	5.548

Table 4. (continued)

Variable	Parameter estimate	Standard error	T for H_0 parameter $=0$
PDPWAGE	0.1098810	0.0267022	4.115
PCABMON	0.0035642	0.0015353	2.322
PCAWAGE	−0.0161594	0.0056725	−2.849
PBMWAGE	0.0228542	0.0039309	5.814
PDPMORT	0.5186800	0.0821012	6.318
PDPCOMM	−0.0293202	0.0294255	−0.996
PDPCONS	−0.1421560	0.0299854	−4.741
PDPLIQD	−0.0232752	0.0337674	−0.689
PDPDIRV	−0.0211658	0.0258041	−0.820
PCAMORT	0.3182220	0.0172493	18.448
PCACOMM	0.0461044	0.0082757	5.571
PCACONS	0.0081054	0.0074284	1.091
PCALIQD	−0.0138471	0.0110827	−1.249
PCADIRV	0.0655366	0.0088322	7.420
PBMMORT	0.0154710	0.0122387	1.264
PBMCOMM	−0.0120827	0.0049632	−2.434
PBMCONS	−0.0026029	0.0027809	−0.936
PBMLIQD	0.0076307	0.0070543	1.082
PBMDIR	−0.0058329	0.0102811	−0.567
WGMORT	0.0687262	0.0376913	1.823
WGCOMM	0.0747101	0.0176336	4.237
WGCONS	−0.0398221	0.0206595	−1.927
WGLIQD	−0.0065267	0.0266401	−0.245
WGDIRV	0.0450004	0.0286681	1.570
LNBRNCH	0.0063400	0.0007436	8.526

F value 5291.578
R^2 0.9951
ADJ R^2 0.9949

Notes: The weight used for WLS estimation is the predicted value of the dependent variable ($\hat{Y}$) obtained from an OLS regression using these same variables, following the procedures in Gujarati (1988). The intercept reported here is thus actually the coefficient on $1/\hat{Y}$.

The adjusted R^2 statistic is 0.9951, and the F-statistic of 5291.6 easily allows rejection of the null hypothesis that all parameters in the model equal zero.

The dummy variable for insolvency using the regulatory accounting principles (RAPINS) indicates that costs are significantly higher for insolvent S&Ls than solvent institutions. For the mean size S&L, costs are estimated to be about US$1.8 million higher for insolvent S&Ls. If a tangible capital standard is used rather than the regulatory capital standard, costs are estimated to be roughly US$3.5 million higher for insolvent S&Ls. This suggests, not surprisingly, that insolvent S&Ls have higher costs than solvent institutions.

Scale economies

The overall and product specific economies of scale are shown in Table 2. In estimating scale and scope economies, input prices were held constant at their means, while the level of outputs was allowed to vary. The overall scale economies estimates indicate slight but statistically significant economies of scale for institutions up through the mean output size. At 150–300% of the mean output range the estimated overall economies of scale are not significantly different from constant returns to scale.

For each of the outputs, product-specific scale economies (PSE) are also calculated. These measures are of more questionable reliability than the overall scale measure since thy focus on single elements of the output vector. With the collinearity difficulties in any model of this type, estimates of cost function behaviour on disaggregated elements are less reliable than those which reflect the behaviour of all elements together. With these caveats in mind, the product-specific scale results can be examined. The PSE for mortgages and liquid investments indicate no significant economies or diseconomies of scale throughout the measured range of output. Commercial loans and direct investments exhibit PSE estimates which indicate statistically significant scale economies at low output levels, which move to constant returns as output increases. At higher output levels, direct investments also exhibit significant diseconomies of scale. Production of consumer loans exhibits some peculiarities. At output levels up to 100% of the sample mean, consumer loans exhibit significant diseconomies of scale, which move toward constant returns at higher output levels. This is the opposite of the pattern which is to be expected from production theory, and which is exhibited by the other outputs.

The results presented here indicate that positive, small overall economies of scale characterize the savings and loan industry through a wide range of output levels. This is generally consistent with the findings reported in Mester (1987b), which found slight economies of scale only at the output mean, and constant returns elsewhere. Moreover, the Mester study examined 1982 data for 149 S&Ls in California. The results presented here are for a much larger sample in a period six years later. These results are not inconsistent with the findings of several recent studies of other types of financial institutions. Noulas *et al.* (1990) found economies of scale for banks up to around US$3 billion in total assets, while Rangan *et al.* (1989) found economies of scale for some banking organizations up to between US$700 million and US$1 billion in deposits. In addition, Gropper (1991) found that economies of scale generally increased for commercial banks over the 1979–86 time period. While this study does not find statistically significant economies of scale for the very largest S&Ls, it does indicate that the majority of S&Ls in the dataset operated under conditions of statistically significant economies of scale.

Scope economies

The results for scope economies are presented in Table 3. These measures represent the estimated reduction in total costs from joint production of outputs, as compared to production in separate specialty firms. For the average S&L, joint production of mortgages, commercial loans, consumer loans, consumer loans, liquid assets and direct investments reduced costs an estimated 4.4% over production in separate firms. As shown, overall economies of scope are positive and statistically significant at a range of output levels from less than 50% of the sample mean to over 200% of the mean, indicating cost savings from joint production. Overall scope economies are highest for the smallest institutions, which suggests that smaller S&Ls can achieve greater percentage cost reductions by diversifying their activities than can large S&Ls. This is to be expected because smaller firms are spreading a given amount of fixed costs over a wider variety of outputs. For larger firms, the given dollar amount of fixed costs are a smaller percentage of total costs, and thus the percentage savings from diversification are smaller. Overall scope economies decline as output levels increase, which suggests that gains from joint utilization of some inputs (particularly fixed facilities and information) are dissipated both by expansion of size and output mix.

Product specific scope economies (PSO) estimate the cost consequences of spinning off production of the specified output. For example, at the sample mean it is estimated that product-specific scope economies for commercial loans are 1.4%. This can be interpreted as the estimated cost savings from combining two firms, one of which produces only commercial loans, and another which produces mortgage loans, consumer loans, liquid investments and direct investments. The PSO estimates for each output generally decline as the level of output rises, and they are similar across outputs at any given level of production. At the smaller size levels, the PSO estimates range from 1.9% to 2.1%, and all are statistically significant. At the sample mean, the PSO estimates decline to between 1.0% and 1.4%, and two of the five estimates are not statistically significant. This pattern continues at higher output levels, so that at 300% of the sample mean, none of the estimated product-specific scope economies is statistically significant. As with the product-specific scale estimates, caution should be used in the interpretation of these results. In addition to the problems discussed in the scale section, the calculation of scope measures requires the prediction of costs for specialist firms, which do not actually exist in the dataset on which estimations were conducted. None the less, these estimates do provide evidence on the cost consequences of changing an institution's product mix. The results obtained here indicate that joint production of these outputs has the beneficial effect of reducing the total costs of operation for S&Ls.

The results reported here suggest that statistically significant economies of scope exist across a wide range of S&L sizes and products. This contrasts with the mixed findings of the previous literature on financial institutions. Gilligan and Smirlock (1984), Gilligan *et al.* (1984) and Kim (1986) found broad evidence of scope economies, while Murray and White (1983), LeCompte and Smith (1990), Lawrence and Shay (1986) and Kolari and Zardkoohi (1987) found a mixture of results indicating some scope economies and some diseconomies. Berger *et al.* (1987) report slight diseconomies of scope. The reasons for these varying results appear to include the alternative financial institutions in the different studies, the different time periods examined within these studies, and differing model specifications and misspecifications as noted earlier. In the most closely related recent studies, Mester (1987b) found no significant economies or diseconomies of scope for S&Ls, while Rangan *et al.* (1989) found scope economies for some banking organizations in 1983, but not in 1986. The time period used in the present study is several years after that used in most of the studies reported above. Because S&Ls should by 1988 have been able to adjust to a less regulated product-line environment, this time period is a particularly opportune one in which to find evidence of scope economies, if they ever existed. The finding of small but statistically significant scope economies adds new evidence regarding S&L costs in a less regulated environment.

VI. CONCLUSIONS

The results of this study suggest that moderate but statistically significant economies of scale and scope characterize the cost structure of a wide range of S&Ls. The finding of scope economies suggests that prohibiting S&Ls from offering commercial loans, consumer loans and other investments would make production of mortgage loans proportionately more costly. This finding also suggests that there is little industry-wide evidence to support the notion that the provision of mortgage-lending services and other lending services should be split apart in an effort to improve the operating efficiency of firms in the S&L industry. Instead, it suggests that offering a diversity of lending services reduces the average cost of production, and may offer opportunities to increase operating efficiency. It is important to note that the joint provision of these various outputs may affect firm profitability, and thus survival, in ways other than simply affecting costs. The opportunity to diversify asset portfolios may allow S&Ls to be more profitable, and it might also reduce the variance of their overall portfolio returns. While individual institutions may lose or gain from the opportunity to expand their activities, the evidence found here suggests that there is no conflict between productive efficiency and product-line expansion for the industry as a whole. In fact, just the opposite is the case. If product-line restrictions were imposed, so that S&Ls could not offer consumer and commercial loans (for example), the overall average cost of mortgage lending would rise. Precise quantification of the magnitude of the cost increase is difficult, but the estimated range of approximately 1–7% cost increases presented here provide a starting point. In today's highly competitive financial services industry, cost increases of even moderate magnitudes may be enough to severely hamper the ability of S&Ls to compete with other financial institutions, and may be enough to drive some S&Ls into bankruptcy. While individual institutions may have experienced difficulty in efficiently offering the newer types of loans in the mid-to-late 1980s, the results here suggest that the ability to offer these products together should provide S&L managers with the ability to operate more efficiently. At least on the basis of costs, this suggests that the product-line deregulation of the early 1980s was not inconsistent with the efficient operation of S&Ls and, further, that recent restrictions may raise intermediation costs for S&Ls.

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